U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-262 064-T

Working Conditions and Health Status of Workers in the Nikopol Manganese Mines

Environmental Protection Agency, Research Triangle Park, N C

1956

BIBLIOGRAPHIC DATA SHEET	1. Report No. EPA TR73-157	2.	PB 262 064

4. Title and Subtitle

Working conditions and health status of workers in the Nikopol manganese mines.

5. Report Date 1956

6.

7. Author(s) G.L. Khazan, Ya. M. Stanislavskiy, Yu. V. Vasilenko, L.V. Khizhnyakova, A.A. Baranenko, V.N. Kutepov et,al.

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

TRANSLATED FROM RUSSIAN BY EPA

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

Translation Service
Office of Administration - Library
Research Triangle Park, NC
27711

13. Type of Report & Period Covered

14.

15. Supplementary Notes

VRACHNEBNOYE DELO (MEDICAL AFFAIRS), 1956, Nos. 1-5,pp. 277-291

16. Abstracts

17. Key Words and Document Analysis. 17c. Descriptors

EPAISD

17b. Identifiers/Open-Ended Terms

OCCUPATIONAL HEALTH

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

17c. COSATI Field/Group 06J 68A

18. Availability Statement THIS TRANSLATION WAS MADE FROM A NON-COPYRIGHTED TEXT.	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 9
	20. Security Class (This Page UNCLASSIFIED	22. Price

EPA-TR 157-73

362034

ORIG

APTIC 48041

WORKING CONDITIONS AND HEALTH STATUS OF WORKERS IN THE NIKOPOL' MANGANESE MINES

[Usloviya truda i sostoyaniye zdorov'ya rabochikh Nikopol'skikh margantsevykh rudnikov]

by

G. L. Khazan, Ya. M. Stanislavskiy, Yu. V. Vasilenko, L. V. Khizhnyakova, A. A. Baranenko, V. N. Kutepov, Z. F. Nestrugina, A. B. Nerubenko and V. P. Protopopova (Khar'kov), Ukraine Central Institute of Industrial Hygiene and Occupational Diseases.

Published in Vrachnebnoye delo [Medical Affairs], 1956, Nos. 1-5, pp. 277-291.

Little light has been thrown on questions of morbidity and work of manganese mine workers in the literature. Only data of the Institute of Industrial Hygiene, Georgian SSR (V. G. Gogibedashvili and S. P. Kipiani, M. E. Machabeli, P. N. Saradzhishvili), on affliction of workers in the Chiatura manganese mines with silicosis and of its absence in them, and, at the same time, of symptoms of manganese intoxication, has been published.

Light has been thrown on working conditions in the Nikopol' manganese mines in the work of L. Yu. Zbarskaya. Despite the great moisture of the ore bed, she found fairly significant dust content in the air of underground workings (2-37 mg on a weight basis). In tests on animals (over a period of 9 months), Zbarskaya noted the appearance of the initial stages of a fibrous process when they were covered with manganese ore dust. P. P. Dvizhkov revealed

(10)

a characteristic picture of manganese silicosis when covering animals with manganese ore dust from the Chiatura deposit.

We set ourselves the task of establishing whether there is silicosis and manganese intoxication among the Nikopol' miners.

The ore bed in the Nikopol' deposit lies horizontally, at a small depth (20-85 m). Its moisture is very high (16-26%). In connection with this, the dust content of the air in the underground workings is not very great, whereas its water content is extremely high. The beds in various mines contain: MnO_2, 5.87-57.86%; MnO, 0.78-22.03%; total SiO_2, 13.0-50%, and 10.1-33.1% free SiO_2 has been found in the bed; that is, about 70% of the total silicon dioxide is free.

Ore production is carried out mainly with pneumatic drills. Cutter-loaders are used in only two areas. Ore loading and its conveyance to the haulage drift is done by hand (there are loading machines and conveyors in only a few areas). In connection with the weak mechanization of these processes, the work of the face crews requiresconsiderable physical effort with the props of large diameter and weight (up to 250 kg).

The air temperature at the face is 14-16° in the summertime, 12-14° in the winter, relative humidity is 85-100%, and air movement is 0.04-0.28 m/sec. The miners do not feel the cold when working, but the body becomes chilled during breaks. Constant chilling of the feet, with the rock temperature lower than that of the air (by 3-4°), as well as cooling when going from the pit head building to the bathhouse, has a particularly unfavorable action. The bathhouses are distances of 50-250 m from the shaft, and there are covered passageways at only three of twenty mines.

Investigation of the dust content of the air at the faces has shown that it fluctuates within the following limits (Table 1).

Table 1

Nature of ore production	Face moisture	Dust content of air	
		in mg/m^3	Number of dust particles in 1 cm^3 of air
Pneumatic dril	dry	1.3-18.6 (mean 9.7)	264-5658
	moist	1.4-19.0 (mean 8.5)	172-2516
Cutter-loader and mobile motor winch	moist	2.6-47.4 (mean 15.2)	904-1563

Analysis of conimetric samples has shown that the quantity of dust particles in 1 cm^3 of air is small (300-600/cm^3) in parts of the faces where ventilation is satisfactory. The SiO_2 content of dust suspended in the air corresponded to its content in the ore (5.6-52.7%) and, in absolute numbers, equaled 0.88-4.32 mg/m^3.

The figures obtained exceed the hygienic standard (2 mg/m^3 for dust containing more than 10% free SiO_2).

The Mn content (calculated on the basis of MnO_2) in dust particles suspended in the air was considerably less than its content in the ore (10-19.6%), which is explained by the great hardness of the manganese concretions in the latter. In this connection, they practically do not break up during production.

The absolute Mn content in 1 m^3 of air during work with a pneumatic drill is 0.1-0.78 mg (about 0.3 mg on the average), which is close to the permissible hygienic standard. It is higher only when working with machines, and it reaches an average of 0.93 mg/m^3 (three times greater than the standard).

In 8 hours of work, breathing in the dusty air, 0.2×10×0.7, that is, 1.4 mg of Mn can enter the body. About 0.6 mg of Mn, on the average, can enter the body in a day, with water containing 0.16-0.27 mg/l of Mn. Meanwhile, laboratory data show that 0.06×15 = 0.9 mg is eliminated from the body with the urine, on the average, and 7.2×3 = 21.6 mg with the feces, about 22.5 mg overall in a day, which is considerably more than enters with dust and water. Obviously, much more manganese enters the body with food, into which manganese enters from dirty hands, than with air and drinking water.

To reveal the presence of dust-borne pathology and manganese intoxication among those working in the manganese mines, specialists from the Institute conducted a medical examination of apprentice workers. Each of them was examined in detail by the therapists, neuropathologists and otolaryngologists. Clinical analysis of the blood was made, the presence of manganese in the biological substrates (blood, feces and urine) was determined and functional tests were carried out at rest and after measured work (pulse, its recovery, respiration rate, holding the breath, arterial pressure). One hundred seventy men were examined in all, with 144 of them underground workers.

They are distributed in this manner by age and experience: up to 40 years old, 40 men (27.6%); over 40 years, 104 (72.2%); with up to 10 years of experience, 105 (72.9%). Thus, three quarters of the underground workers examined had more than 10 years of experience and were over 40 years old [sic].

The medical histories revealed that 29 underground workers (19.2%) had suffered pneumonia while working in the manganese mines.

The men examined principally complained of pains in the chest, dry cough, more infrequently with emission of sputum, shortness of breath after physical effort, rapid fatigue, and pains in the joints and lumbar region.

Upon analysis of the data obtained, information on the state of health of underground workers, with dust-borne pathology and without it, was summarized. We included persons in whom manganese silicosis was either detected or suspected in the group with dust-borne pathology.

It is known that manganese compounds can cause a chronic pulmonary disease, manganese silicosis. Its rate of development depends on the length of time worked.

According to our data, dust-borne pathology was detected in 28 of those examined (18.5%), and manganese silicosis was suspected in 22 men (14.5%), including three, in whom focal pulmonary tuberculosis in the consolidation stage was revealed at the same time. Focal pulmonary tuberculosis in the consolidation stage was detected overall in 12 men (3%). Underground workers with first degree manganese silicosis were examined again in the Institute clinic, and this diagnosis was confirmed. It was recommended that they be assigned to work on the surface, be put on a pension and that general restorative therapy be carried out, including therapy under sanatarium-health resort regimen conditions.

Of 28 underground workers in whom dust-borne pathology was revealed, 21 belonged to the face crew, with experience only in manganese mines (miners, cart men, mine haulers). First degree manganese silicosis was diagnosed in 5 men, this disease was suspected in 13, and manganese silicosis, simultaneously with focal pulmonary tuberculosis in the consolidation stage, was suspected in 3. The remaining 7 men in whom dust-borne pathology was revealed work in other production.

Thus, dust-borne pathology was detected mainly in the face crew of miners. The course of manganese silicosis was favorable.

The X-ray picture of manganese silicosis, according to our data, is characterized by the presence of a marked fine-mesh and linear fibrosis. In first degree manganese silicosis, fibrous nodes about the size of a pin

head are detected on the background of the fine-mesh fibrosis. The roots of the lungs are thickened and dilated.

As to diseases which accompany manganese silicosis, it must be emphasized that the frequency of bronchitis is low in both the group with dust-borne pathology and in the others. This is explained by the fact that chronic bronchitis frequently is combined with emphysema of the lungs and frequently is masked by the latter (A. Ya. Tsigel'nik, Yu. N. Sokolov).

As is well known, emphysema of the lungs, especially basal emphysema, accompanies dust-borne pathology (N. A. Vigdorchik, V. N. Yanovskiy, O. M. Genkin, N. A. Kovnatskiy). According to our data, emphysema of the lungs was found in 82% of those examined in the group with dust-borne pathology and in 50% in the group without it.

It must be noted that diseases of the cardiovascular system are encountered one and a half times more frequently in the group with dust-borne pathology.

Great attention is deserved by the diseases of the sustentacular-motor apparatus (arthralgia) and diseases of the peripheral nervous system (chronic radiculitis) which have appeared. The density of arthralgia among those examined is fairly high, 23-28%. A fourth of those examined suffer from chronic radiculitis and, if the so-called radiculalgia is taken into consideration, even 38%.

Functional tests are of great assistance in deciding on the respiratory function. We detected bradycardia in only 10-13% of those examined, and tachycardia in 14-17%. Spirometer data were within the normal limits in a significant majority. According to our data, even in the rest state, the functional Stange and Sobrase tests permit the conclusion to be drawn of a reduction in the respiratory function because, in one third of those examined,

the breath-holding test in this state was less than 30 sec. The same applies to the test of holding the breath after exhalation.

Arterial pressure in 81-89% of the cases was normal, hypotonia was noted in 7.4-4.1% of those examined and hypertonia in 11.1-6.7%.

The clinical picture of the blood is characterized by a high level of hemoglobin, an increase in number of erythrocytes from 5 to 5.5 million, accelerated erythrocyte sedimentation test, lymphocytosis and monocytosis. A high hemoglobin level appeared in 70% of the chargers examined. A moderate reduction in leukocytes (4500-5900) and eosinopenia were more pronounced in the group with dust-borne pathology. A monocytic reaction was expressed to some degree in the cutters. A clear monocytic reaction was noted in miners inhaling manganese dust by Erisman, Lloyd-Davis and Harding (according to Lazarev).

Moving from evaluation of the results of determination of manganese in biological substrates, it must be emphasized that diagnosis of intoxication has some importance, although there is no complete correlation between clinical data and the results of laboratory analysis.

On the basis of data in the literature, from 0.012 to 0.015 mg% of manganese is found in human blood according to Petty, and up to 0.05 mg%, according to G. A. Alyab'yev. The greater part of the manganese is eliminated with the feces normally (in accordance with the data of Alyab'yev, the manganese content in feces is up to 1.8 mg%), and less of it in the urine (from 0.001 to 0.5 mg%, according to Lazarev).

In the presence of an increased manganese content in water and food stuffs, these norms can be higher in manganese mines. According to our small amount of data, manganese in the biological substrates gives the following variations in the

control group: from 0.02 to 0.03 mg% in blood, from 0.04 to 0.06 mg% in the urine and from 2.4 to 4.2 and even, in one case, 9.0 mg% in the feces.

Comparing our data on manganese content in the biological substrates in underground workers, we can establish certain relationships among the manganese levels in blood, feces and urine. Thus, in 28 underground workers, in whom blood Mn was within normal limits (0.01-0.02 mg%), its content in the feces was increased in 53.7% of the cases (from 5.0 to 20.0 mg%), and in 40 underground workers with an increased blood manganese content, from 0.03 to 0.1 mg%), it was detected in the feces in 85% of those examined (from 5.0 to 20.0 mg%). Thus, the greater the blood manganese, the more often an increased amount of it is found in the feces. A similar relationship between the blood manganese level and its content in the urine could not be established.

Marked forms of manganese intoxication were not found in the underground workers examined. In precisely the same way, no cases of the initial forms of intoxication were discovered, with the presence of characteristic neurological symptoms. However, considering the great difficulty in exposing the initial forms of this poisoning, we displayed great caution in categorically excluding manganese affliction of the nervous system.

Considering data in the medical histories, subjective complaints and neurological symptoms permitted diseases of the nervous system to be distinguished in a total of 79 men of the total number of those examined. They are distributed in the following fashion:

a) disease of the peripheral nervous system in 40 men, in the form of sacro-lumbar radiculitis in 33 of them (21.8%);

b) functional diseases of the central nervous system, in the form of autonomic-asthenic or neurasthenic syndromes, in 16 men (10.5%);

c) organic diseases of the central nervous system in 14 men (9.2%), with symptoms of sclerosis of the brain vessels in 11 men of this group;

d) the assumed presence of the initial stage of chronic manganese intoxication in 9 men (6%). This group must be given an additional, comprehensive examination in the Institute clinic.

This is the condition of the upper respiratory passages: among 92 persons without dust-borne pathology examined, hypertrophy of the mucous membranes (27% of the cases), and an atrophic condition in 7%, distorted nasal septum in 11% and chronic tonsilitis in 6% were the principal findings.

In persons with dust-borne pathology, the atrophic condition of the upper respiratory passages was noted almost twice as frequently as in persons without it. Evidently, a somewhat increased angina morbidity is a consequence of frequently aggravated chronic tonsilitis.

Periodic medical examinations, with mandatory X-ray photography, must be organized and systematically carried out, in order to reveal the prevalence of manganese silicosis and to prevent its development. Ventilation of underground workings should be improved, and dust wetting should be applied when machines are working in a dry face.

It is extremely important to mechanize the heaviest work and to improve the removal of ground water, and to introduce massive ultraviolet irradiation of the workers as well, for the purpose of prophylaxis of diseases of the sustentacular-motor apparatus (arthralgia, chronic radiculitis and radiculalgia).